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# Business Intelligence Dashboard in Decision Making

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# Business Intelligence Dashboard in Decision Making

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A Directed Project Report

By
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|---|---|---|
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## ABSTRACT

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Efficient internal processes contribute much towards the growth and success of any organization. As an organization grows, the amount of data required in an organization also becomes massive. Collecting and analyzing vast quantities of data can be a tedious process. Lack of availability of data in the right form at the right time can result in a delay in a decision that may need to be made related to that data. The main goal of this project is to analyze the use of business intelligence dashboards for decision making processes among various departments in a manufacturing organization. The study focused on understanding the extent to which the employees in the manufacturing organization used the functionalities provided by the business intelligence dashboard. The project dealt with conducting in depth interviews and surveys with employees from three different departments in a manufacturing organization.

# SECTION 1. INTRODUCTION

This chapter provides an overview to this research study and to this proposal. This chapter focuses on the significance of this study and its contribution to the current body of knowledge. This chapter helps in defining the scope of this study through research questions, assumptions and limitations. It helps understand the problems faced by several departments in a manufacturing company and its significance in terms of time and cost. Some commonly used terms are defined in this chapter also.

## 1.1. Background

Data is very valuable to any organization. The flow of information within an organization is critical to the success of that organization (Davenport & Prusak, 1998). Organizations struggle in collecting data, retrieving information and making decisions based on the extracted information**.** A decision making process consists of making judgments regarding several investments and resources based on the quantitative and qualitative data. There are several different systems like data warehouse, Enterprise Resource Planning (ERP), etc currently used by organizations for decision making processes. These systems have progressed tremendously in the last few years by making large amounts of information accessible using data marts and data warehouses (Wixom & Watson, 2001). These systems allow managers to analyze data depending upon the business requirements. These systems have made the decision-making process easy to a certain extent, but if not used effectively, they can prevent optimization of the decision making process.

Decisions in any organization are made by humans and not by systems and as a result presentation of data plays a significant role in the decision making process**.**

Thus, the goal of this study was to understand how different departments in a biomedical device manufacturing organization are making use of dashboard(s) for data analysis and within the decision making process. This study also made a comparative analysis of the use of different functionalities offered by a dashboard in three functional areas of the organization. Different departments in an organization use a dashboard differently to serve their unique needs. The way departments use a dashboard may make a difference between failure and success. Sales and Marketing generally use a dashboard to forecast sales, collect information on pipeline, unit orders, and prices (Malik, 2005). Supply Chain uses a dashboard to manage distribution, inventory, logistics, and monitor return rate (Malik, 2005). The IT department makes use of a dashboard for managing resources, scheduling, and calculating cost and time on any project

## 1.2. Problem Statement

The study specifically sought to determine the optimal use of a business intelligence dashboard among different departments (Sales and Marketing, Supply Chain and Information Technology) within a biomedical device manufacturing organization. An enterprise dashboard provides a condensed visualization of a company's performance. When designed appropriately, it is an easy-to-use application where any kind of qualitative or quantitative data is represented graphically and is easy to understand. In today's global market the success of any department depends on its ability to make quick intelligent decisions related to complex problems. Different departments in an organization use a dashboard differently to serve their unique needs. Any employee in charge of making a decision has to deal with a large amount of data; dashboards make it easier to comprehend large amounts of data. In the scenario of business activity that lacks a dashboard, if an executive wants to compare data and make any decision based on it, he or she needs to go through a lengthy process to get the relevant data for comparison. Several times the data is presented in different formats, which creates issues of

compatibility. A dashboard helps in capitalizing the revenue and optimizing the business processes.

## 1.3. Significance

A decision-making process is an important process for any organization; decisions made by managers or executives are very crucial for the success of any organization. Any large or small organization today must optimize its strategic decision making process. With a sharp increase in data collection due to the growing global market and customization, the decision making process needs to be fast and more accurate**.** In a report generated by the Enterprise Strategy Group (1999), nearly 11% of large organizations gather more than 10 TB (terabyte) of data every month that comes from more than 10,000 sources**.**

In a bio-medical device manufacturing organization several departments that lack a dashboard make use of a data warehouse that serves as a single data repository. Data warehouse has made the decision making process easier compared to decentralized approach, but decision makers still have to depend on the Information Technology (IT) department for data collection and report generation. Due to several problems related to this set-up (like turnaround time, availability of data and the human effort involved in running queries and reports), the decision making process cannot be made more efficient and can affect the growth of the department. Any department that does not have a dashboard has to request data from the IT department; the IT department then has to run the necessary queries and send the data back to the user. This process is time consuming due to the workload and pending requests being resolved by the IT department. Thus, even if the data is required urgently and a decision needs to be made based upon that data, the user has to wait until the IT department gets back to the user. Being dependent upon the IT department delays the whole decision making process.

A dashboard provides an interface that aids managers and executives in getting data immediately from various departments in a similar format and makes it more accessible. Dashboard design also plays an important role in decision making

process. It should be easy to use and should consist of all the capabilities like customization, audience targeting, color display, etc as mentioned in the literature review to facilitate the decision making process. Depending on the specific business application where a dashboard is used, the design and functionalities may vary.

## 1.4. Statement of Purpose

The purpose of this study was to analyze the use of a Business Intelligence (BI) dashboard within three departments in a biomedical device manufacturing organization using the experience, attitude, and perspectives of individuals from a manufacturing organization. The research question for this study was “How are three different departments (Supply Chain, Sales and Marketing and Information Technology) within a biomedical device manufacturing organization using a BI dashboard for decision making?” Understanding the users’ (decision makers’) perspectives and experiences of a dashboard would lead to a better understanding of the usage of dashboard in the decision making process.

## 1.5. Assumptions

The following assumptions have been made for this study:

1. Participants will respond honestly and accurately during the interview process.
2. Participants are allowed to skip the question that they do not want to answer.

## 1.6. Limitations

The following limitations have been made for this study:

1. Comparison between the usage of dashboard will be drawn based on data from three departments.

2. The study is limited to the amount of cooperation of the manufacturing organization.

## 1.7. Delimitations

The following delimitations have been made for this study:

1. A period of three months is available to interview the participants.
2. Decision making processes consist of a sequence of steps involved in collecting data, analyzing data and making decisions based on them. Any other decisions that are not related to analyzing and comparing business related data would not be considered in this study.

## 1.8. Definitions of Key Terms

The key definitions used in this study are defined below:

Business Intelligence: 'Business intelligence (BI) is a data-driven DSS that combines data gathering, data storage, and knowledge management with analysis to provide input to the decision process.' (Solomon Negash, 2008, p.6)

Dashboard: A dashboard is a single screen user interface consists of a static structure which makes information available at the right time using indicators. (Golfarelli, Rizzi, & Cella, 2004).

Data warehouse: **'**Data warehouses are databases devoted to analytical processing. They are used to support decision-making activities in most modern business settings, when complex data sets have to be studied and analyzed' ("Designing data marts for data warehouses," 2001, p.452)

Data Visualization: A special aspect of user interfaces the means for communicating structures and processes, which may be shown in abstract or representational forms. Classically, these may be described as tables, forms, charts, maps, and diagrams (Marcus, 2006).

ERP Systems: **‘**ERP systems are transaction-processing focused and weak on analytics’. (Liang, 2001, p.15)

Executive Information Technology (EIS): EIS is a subset of a class of technology solutions that also are referred to in the industry as business intelligence (BI) software. EIS seeks to provide a management information portal to support strategic activities such as goal setting, planning and forecasting, and tracking performance. (Liang, 2001, p.15)

Information: ‘Significant patterns of organized data’ (Marcus, 2006, p.1).

Online Analytical Processing (OLAP): **‘**The term OLAP (On Line Analytical Processing) refers to data analysis over large collections of historical data (data warehouses), in order to support the decision making process, allowing the analyst to perform analysis of factual data (e.g., daily sales in the different branches of a supermarket chain) according to dimensions of interest (e.g., regions, products, stores, etc.)**’** (Hurtado, Mendelzon, & Vaisman, 1999, p.1)**.**

User Interface: ‘A computer program is the part that handles the output to the display and the input from the person using the program’(Myers, 1995, p.66).

## 1.9. Summary

This chapter provided an overview to the project, including background, problem statement, significance, purpose, definitions and scope of this project. The next chapter outlines the history of business intelligence systems and their limitations

# SECTION 2. LITERATURE REVIEW

This chapter provides an overview of the research done in the field of Business Intelligence (BI). The first section provides a brief overview of the history of BI systems. The later part of this chapter discusses the importance of BI systems; some commonly used BI systems for decision making, limitations of BI systems and design issues.

## 2.1. Overview of this Review

Much has been said and written about BI systems. To begin the research, study begins with collecting information from periodicals, journals and reports. BI systems are used almost in all the sectors of industry for different purposes like reporting, analysis and decision making. This research concentrate specifically on its applications for the decision making process .This section provides information from several articles that I believe are relevant to this area.

## 2.2. Introduction to BI systems

This section will provide brief information about BI systems, touching on major topics and development in this field as a whole.

As organizations gained a stronger global presence, information was utilized by different groups of people that included stakeholders, accountants, managers, customers and several others. Executives and managers spend a large amount of time scanning for information and making decisions (Vedder, Vanecek, Guynes, & Cappel, 1999). There are several variables involved that affect the human decision making process. Some of the variables that significantly influence the decisions

made by humans are race, religion, personality, age and education(Ford & Richardson, 1994). Managers make both structured and unstructured types of decision in any organization. An example of a structured decision is Accounts Receivable, Short-term forecasting, Inventory control, etc while unstructured decision includes Sales and Production, Cash Management, etc (Gory & Morton, 1971). Depending upon the area of work, decisions made by managers may vary. This led to the evolution of the data centralization phase in 1990 (Hoffmann, 2007).

Data warehouses and data marts first appeared to provide a centralized system for accessing data and making tactical decisions. Such systems were considered as to fall under the classification of BI. The main goal of a business intelligence system is to support the decision making process. A BI system can be defined as ‘a process of turning data first into information and then into knowledge’ (Golfarelli, Rizzi, & Cella, 2004, p.1). Figure 2.1 shows a hierarchical view of a BI process.

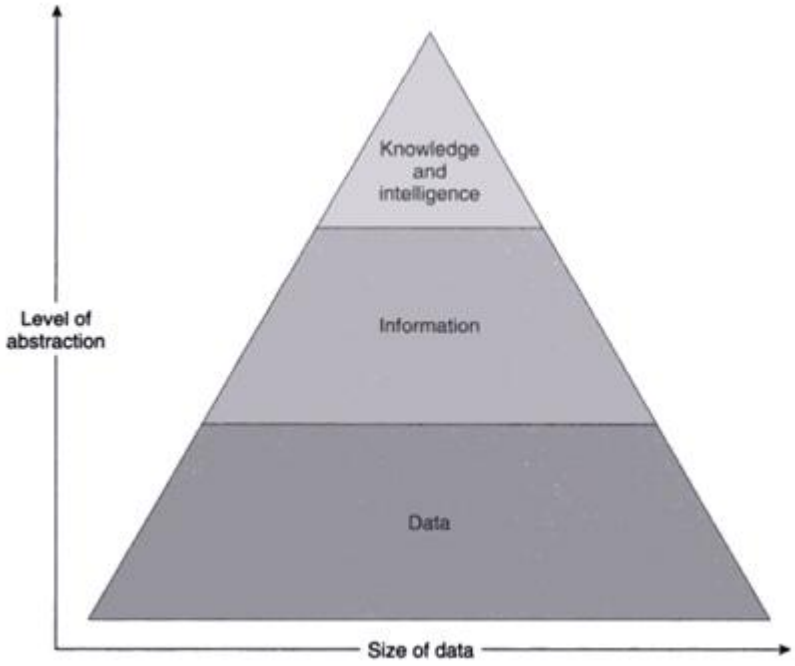


*Figure 2.1.* Example of a BI Process (Loshin, 2003).

A BI system provides managers and executives with in-depth information and a systematic understanding of an organization’s operations (Thierauf, 2001). A BI

system overcomes the decentralization concern of the business decision making process and makes the process more efficient. It helps in identifying problems encountered in any project and provides an analysis related to any variant in the project (Olszak & Ziemba, 2006).

A 2006 report by Davis (2006) discussed a case study of Continental Airlines, which implemented a BI system to optimize their business decisions and processes. The main problem faced by the company was the information flow between the different departments in the organization. There was no specific system to keep track of historical data and analyze them. Continental Airlines required a system to consolidate the data from different departments at a higher level, which would make accurate information available throughout the organization. The main goal of the company was to make data available in an integrated and consolidated manner to the users, processes and applications. The solution adopted by the company was to implement a BI system. As a result of the implementation of the BI system, Continental Airlines realized several benefits as listed below (Davis, 2006):

- Improved problem solving
- Better customer experience
- Improved reporting and analytics capability
- Optimized business functions

There are several types of BI systems such as data warehouse and ERP currently used in organizations for high performance data management and data analysis. Though BI systems have removed the decentralization of data and progressed in managing information, an attempt has not been made to make the information available efficiently. For a BI system to be successful, it is necessary to have suitable infrastructure that allows capturing the information and disseminating them to the decision makers effectively (Thierauf, 2001). BI systems should be designed with an understanding of the human perspective and consideration of

some factors like visual displays, interface design and other interactions that nurture human ability (Few, 2006).

## 2.3. Comparison of BI systems

In the mid 1990s, the BI system that was widely accepted was the data warehouse. A data warehouse is ‘a subject-oriented, integrated, time varying, non-volatile collection of data that is used primarily in organizational decision making’ (Chaudhuri & Dayal, 1997, p.1). Though a data warehouse was commonly used, it was only beneficial to people who were highly computer-literate. The main problem faced by the business users while making decisions is navigating through huge data marts or data warehouses and correlating the information. In order to access the data business users have to be dependent on the IT department (Price, 2006). BI dashboards help in solving this problem by consolidating and making information available on a single screen. A BI dashboard allows business users to have complete control over how they manage the data while IT can be more involved with technology integration, maintenance and support. Severing this interdependent relationship results in faster and better decisions (Price, 2006).

The quality of decisions depends highly on data quality. Availability of data is also considered as a data quality issue. As compared to a data warehouse, the data in a dashboard comes from multiple sources including data warehouses, spreadsheets, internal applications, external services and stand alone applications (Farcot & Kades, n.d.). In a survey carried out by Hurwitz and Associates (2005), it was found that the companies relying on data warehouses and stand-alone databases meet less than 50 percent of their business requirements. According to the survey, most of companies incorporate their data warehouse and external applications to the dashboard to achieve better performance. Nearly 95 percent of the IT executives surveyed recommended a dashboard as a tool to offer consistency, reliability and accuracy necessary for better decision making capabilities (Hurwitz, 2005).

ERP systems are also one of those tools that are expected to improve the decision making capabilities at the executive level. Organizations relied on financial systems (Enterprise Resource Planning (ERP)) for analysis and reporting. Though they were strong in transaction processing they were not efficient for running queries and report generation. ERP systems were not designed to run user-specific reports (Davison, 2002). However, such reports are necessary for the decision making process in any organization. As noted by Bellomo (1999) , 'ERP systems are a goldmine for valuable business intelligence. Unfortunately, ERP reports generally provide a fraction of the useful information in the system.' ERP systems enable integration of different business processes using a single data repository. (Zaitun & Zaini, 2008). Data in the system comes from a single source, which limits the information being extracted. In the past few years, the need for ERP systems and data warehouses has increased, but the problem of making data available to the users in the format required by them still exists. The main reason for its limitations is that ERP systems lack in providing a dashboard (Liang & Miranda, 2001).

During 2001, due to the limitations of previous systems and dynamically changing business requirements, a need for a new tool arose that would help the managers and executives keep an eye on the organization's performance without navigating through complex databases (Golfarelli, Rizzi, & Cella, 2004). The new BI model needed to be designed such that it would not require tactical and operational decision makers to run the online analytical processing sessions (OLAP); it would make data available in the form of reports and indicators that would lead to improved performance. Crucial design issues that include data quality, light architecture and indicators would have to be incorporated in the BI system (Golfarelli, Rizzi, & Cella, 2004). The result of these limitations was the creation of the dashboard.

As compared to other BI systems, dashboards have made the process of analyzing data easy for the analysts by providing data through a single user interface. Prior to the existence of dashboards, analysts were required to go through stacks of data in order to calculate profits, expenses and quarterly results. A dashboard consists of a static structure that makes information available at the right time using indicators (Golfarelli, Rizzi, & Cella, 2004).

During harsh economic times, optimization of business processes to cut cost and time is very essential. Dashboards have been shown to be a beneficial investment in such times. The main benefits of the the utilization of a dashboard are (Hurwitz, 2005):

- Representing performance information in a graphical format allowing users to rapidly recognize performance issues.
- Analyzing performance information in a structured manner within the context of goals and objectives.
- Helping to facilitate better decision making and reducing the costs incurred in manual information gathering.
- Assisting with reducing costs related to administrative or manual work.

## 2.4. Dashboard Design Issues

User interface design is vital to any computing system as it affects users productivity and efficiency (Few, 2006). A dashboard provides a rich user interface that displays the information in a graphical form using a variety of elements including charts, tables and gauges**.** These elements reduce the time spent on analyzing the data using databases and thus assist in automating the business decision making process (Malik, 2005). This section of the literature review points out the design elements that may lead to failure or success while designing a dashboard, as a critical component of their effectiveness depends on their design. A dashboard management system should focus on interface design, accessibility and security. Dashboards should be easy to use, web accessible and business driven. For an organization, cost also plays an important part, so dashboards should be affordable and easy to deploy as well (Eshraghi, 2008).

Because a dashboard can be used for different functions by different people, it should be highly customizable for different users and different scenarios (Resnick & Miami, 2003). It should display only appropriate information required by the decision makers to do their job. The display mechanism also plays a significant role in decision making. While displaying information, the manner (means of display) in which information is presented is very crucial (Few, 2005). Color selection plays a vital role in dashboard design. Dashboards used for visual mining make use of colors like green, yellow and red to show good, satisfactory and bad performance (Few, 2006) . Figure 2.2 is an example of award winning sales dashboard submitted by Robert Allison of SAS.

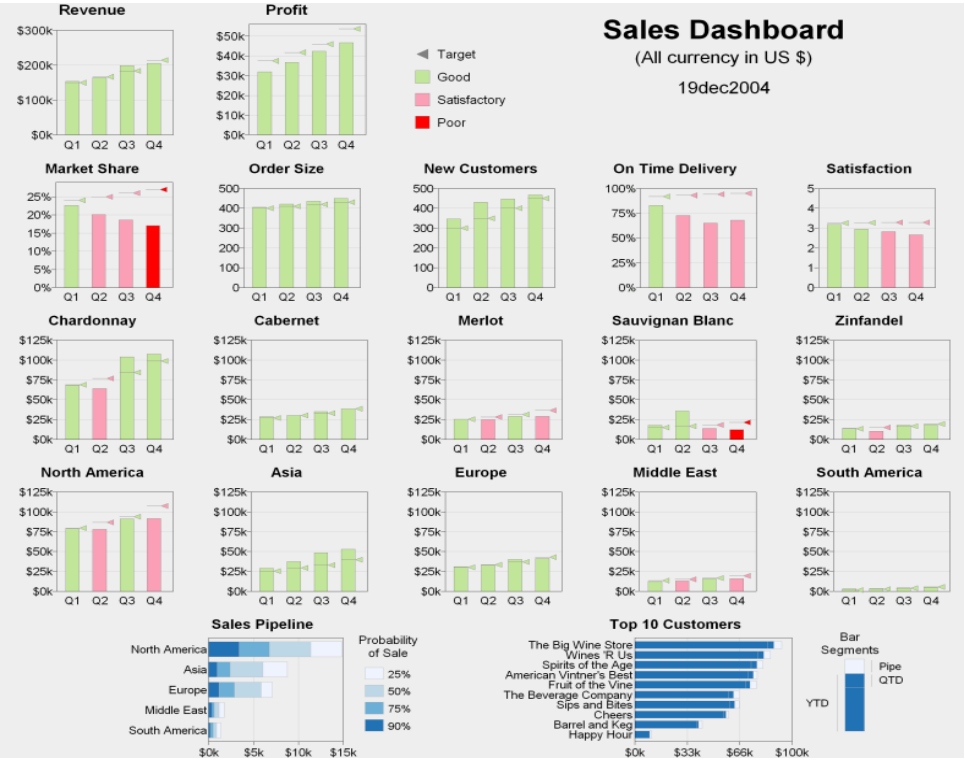


*Figure 2.2* Example of Sales Dashboard (Few, 2006).

Color selection should consider factors like culture, color blindness, etc. Red and green colors are generally used to show bad (red) and good (green) signs. The same color should not be used for different purposes (Few, 2006). For example, if light green and light red are used for showing good and bad performances respectively, they should not be used anywhere else for different purposes.

Important information should be highlighted using large boxes or bright colors that enable the user to take instant actions (Eshraghi, 2008). A dashboard design should be carefully considered while implementing a dashboard; it should not be a result of 'gauges, flashy traffic lights, meters but rather a simple knowledgeable design' (Few, 2006, p.4). Though gauges and flashy traffic lights look nice, they lack in communicating the information. Research done regarding the use of graphics in learning suggests that simple drawings are more efficient in communication compared to the gauges and meters that add visual noise and prove distracting to the users (Clark, Lyons, & Hoover, 2004).

Different vendors have different proposed designs for dashboards. A Hyperion Solutions dashboard contains graphs, reports and tables that allow data to be displayed in a different manner. Corda Technologies provides the ability for the user to drill down in the graph and access additional information. There are some features that should be considered while designing an interface. The features stated by Hall (2003) in a report are as follows:

1. A dashboard should be able to filter, sort and analyze the data.
2. A dashboard should have the drag-and-drop functionality available.
3. It should provide drillable charts and graphs.
4. It should be multilingual.
5. It should be able to create alternative scenarios.

There are some common pitfalls encountered while designing dashboards that should be avoided while designing the user interface for a dashboard:

- **Information overload** (Cleverley, 2001; DeBusk, Brown, & Killough, 2003): Too much information can make the dashboard look cluttered and can easily distract the users. Detailed information should be provided on users' demand.

- **Limited Information**: An effective dashboard cannot contain only present or historical data. To make a dashboard usable it should possess a combination of all kind of data.
- **Complex user interface** (Collier, Marini & Minsker, 2008) : Dashboards are usually meant for executives and managers who have less time to learn a new technology. The navigation should be designed such that it is easy for users to navigate through the dashboard without any pain.
- **Security** (Eshraghi, 2008): Security is also an essential element while implementing a dashboard. Audience targeting and role-based security should be provided to ensure data integrity

## 2.5. Summary

The research described in the prior sections has contributed towards the BI dashboard literature. The literature helps in understanding the BI systems, difference between BI systems used for the decision making process and provides knowledge about design issues that affect the decision making process. The following section will describe the methods used for measuring the effect of BI systems.

# SECTION 3. METHODOLOGY

This study focused on users who are familiar and have experience working with a Business Intelligence dashboard in order to compare its usage for decision making processes between different departments in a manufacturing organization. The study specifically targeted the experiences of the participants and tried to determine if a correlation existed between usage of the dashboard and a resulting improvement in the decision making process. It also tried to determine the extent to which participants make use of different design features provided by the dashboard.

Due to the nature of the research question, a case study was deemed the best suitable approach. This chapter outlines the methods, sample size and specific study procedures. According to Stake (1995) data in a case study can be collected by conducting interviews. The case study research method is used for studying organizational issues and technology development (Yin, 1993). In order to add a numeric description of the opinions and attitudes of the population, a survey was conducted in addition to the interviews.

## 3.1. Methodology Review

There are several tests used to asses various aspects of BI systems. Case studies and survey questionnaires have been used extensively in Information Technology (IS) (Smith, 1990). Data are collected using surveys, interviews and longitudinal studies with employees from organizations (Gable, 1994).

A survey was conducted by Hurwitz (2005) to measure the effect and assess the requirements for deploying a dashboard. IT executives that were actively involved in decision making and had experience working with a dashboard were surveyed. According to the executives, the main benefits of using a dashboard were time efficiency, increased revenue, increased customer satisfaction and increased

productivity. A qualitative study can be studied in natural settings and the researcher can understand the nature and complexity of the problems associated with the process (Benbasat, 1987). Depending upon the nature of study, diverse types of data is required to validate the results. Mixed methodology enhances the strength of study by collecting and analyzing qualitative as well as quantitative data (Creswell, 2008). To understand the effect of a dashboard in three different departments in-depth interviews and survey were conducted in this study.

## 3.2. Study Design

The following section provides detail concerning the design, study site and participants selected for the study. The study consisted of two separate parts. A literature review carried out for this study examined the impact of different business intelligence systems on users in different organizations. In the second part of the study, in-depth interviews and surveys were conducted with employees from a manufacturing organization located in the state of Massachusetts. The organization is one of the leading biomedical device manufacturing organizations and has been a pioneer in the industry for the last 25 years. The population being considered for this study was a group of employees who are familiar with business intelligence dashboards and have experience working with them. According to Creswell (1998) the number of participants to be selected in a qualitative study should be 10. More (1994) recommends at least six participants to be selected to validate the results. As the basis of this research, I had selected to interview five-seven employees from the manufacturing organization who have experience working with a dashboard. A Survey was conducted with the employees from three different departments (i.e. Supply Chain, Sales and Marketing and Information Technology).

## 3.3. Specific Procedures

The study begins with the literature research on different systems used for decision making and the problems faced by the users while using the existing systems. The literature review outlines the benefits of using a dashboard and enlists

the design features of a dashboard that can optimize the decision making process. Before initiating the second part of the study Human Subjects approval (IRB) was taken from Purdue University (Appendix A). After getting permission, data was collected from three different departments using basic background questionnaire, survey and individual, semi structured interviews. Employees were initially asked to fill out a survey attached requesting them to rate the functionality commonly used by them during data analysis and decision making process. The survey questions that were asked are shown in Appendix C.

The next step was to collect data using a background questionnaire and conduct in-depth interviews with the employees. The data collected from the participants of three different departments was used to draw a comparative analysis on the effective use of a business intelligence dashboard for the decision making process in each of these departments. Some sample questions that were asked in the questionnaire are shown in Appendix B.

Based on the information collected during the questionnaire participants were selected for the interview. The next step was to interview five to seven participants in 20 to 30 minute interviews that took place in controlled settings. The interviews were digitally recorded and transcribed to a word processing program. The audio tapes were discarded once data has been analyzed. The interview started with validating the general information gathered using questionnaire. Eventually the interview started delving into each individual's experience with dashboard and how it helps them in improving the decision making process. Appendix D shows the entire list of questions that were asked during the interview. Table 3.1 shows the Tasks, Activities and deadlines associated with this paper

## 3.4. Time Action Plan

Table 3.1 shows a listing of the major activities within this project and the dates on which they occurred.

Table 3.1.

*Project Time Line*

| **Task** | **Activity** | **Deadline** |
|---|---|---|
| Project initiation and Proposal Submission | Develop a project charter and submit final draft of proposal to the committee for suggestions and changes | June, 2009 |
| IRB Approval | Get the methodology approved by IRB | June, 2009 |
| Proposal Approval | Incorporate changes suggested by committee members and get the idea approved | July, 2009 |
| Survey | Survey will be conducted with employees from the three different departments | September, 2009 |
| Interview / Questionnaire | Carry out in depth interviews with experimental subjects | September, 2009 |
| Data Analysis | Conduct Data Analysis | October, 2009 |

Table 3.1.

*Project Time Line*

| Task | Activity | Deadline |
|---|---|---|
| Report Submission | Submit first draft of report to the committee | December, 2009 |

## 3.5. Time Action Plan

Figure 3.2 displays a Gantt chart of the project and its deliverables.

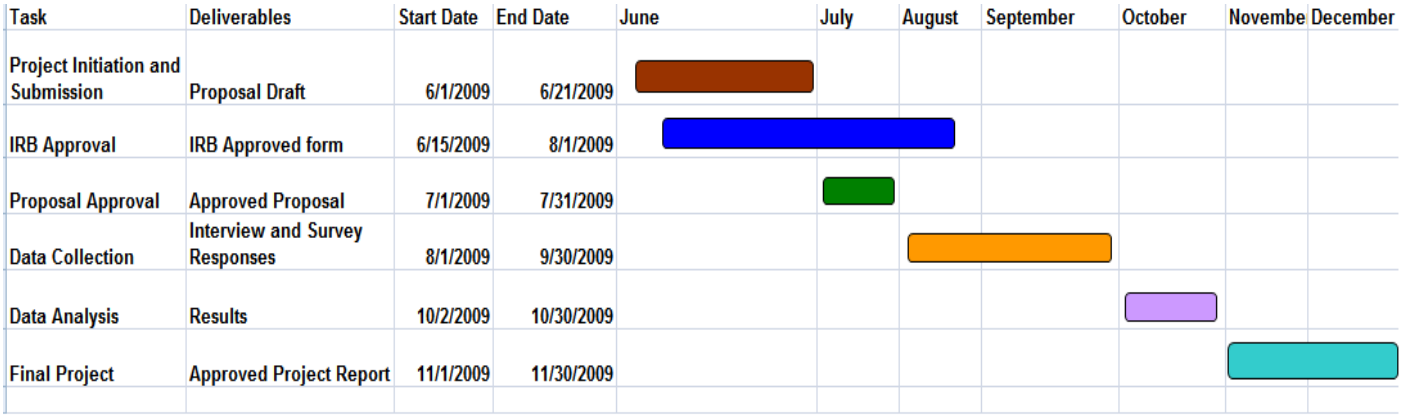


*Figure 3.2.* Project Time Line

# SECTION 4 DATA COLLECTION

This section describes the data collected from individual sources. It also provides description of participants who took part in this study. As stated in previous chapters the purpose of this study was to describe and analyze the experiences of different individuals among different departments who use a business intelligence dashboard. Unstructured interviews and surveys were used to extract the information presented here. As this chapter presents the data, a comparative analysis and conclusion is presented in Section 5.

## 4.1. Participant Description

The following section introduces all the participants who took part in this study. As discussed in chapter 3, five to seven participants were used for in-depth interviews and nearly 30 participants were to participate in a survey. The participants selected for interviews and the survey had some form of previous experience working with a dashboard.

### 4.1.1. Interview Participants

The information provided in these sections is collected using a background questionnaire (see appendix B) that was handed to each participant at the beginning of this study. In order to collect anonymous data, a number had been allotted to each participant. All the participants who took part in the interview were either a project manager or Manager I.  Participants 1 and 3 were from the Supply chain department. Participants 4 and 5 were from Information technology (IT) and 2 and 6 were from Sales and Marketing.

#### 4.1.1.1. Participant 1

Participant 1 (P01) was a female employee from the supply chain department with 14 years of industry experience. P01 stated that she had strong technical knowledge with experience in scripting and coding. P01 had previously worked with a data warehouse and had experience working with a dashboard. As part of a supply chain team P01 frequently needed data for analyzing and making decisions.

#### 4.1.1.2. Participant 2

Participant 2 (P02) was a female sales and marketing employee with 23 years of industry experience. P02 also acknowledged that she had been working as a project manager for the past six years. Her expertise included data reporting and analytics. P02 considered herself highly computer literate. In addition to having worked with data warehouse, which is a business intelligence tool, P02 also had experience working with Crystal Reports. P02 reported that she was not familiar with any programming or scripting language.

#### 4.1.1.3. Participant 3

Participant 3 (P03) was a male from the supply chain department at a biomedical device manufacturing organization. He had previously worked in a manufacturing plant. He had four and one-half years of industry experience. His expertise included warehouse and inventory management. He needed data frequently for data analysis and decision making. He used a dashboard for analytics and business decisions. He was not familiar with any scripting or programming languages.

#### 4.1.1.4. Participant 4

Participant 4 (P04) was a male working in the information technology department. He had 11 years of industry experience. He considered himself highly computer literate and had previously worked with a data warehouse. He stated that he needed data frequently for analyzing and making decisions. He was not very familiar with any scripting or programming languages. He had initially worked with few scripting languages but he no longer used them.

#### 4.1.1.5. Participant 5

Participant 5 (P05) was a female employee from information technology who had a strong finance background. P05 had worked with a dashboard and a data warehouse in her previous job. P05 had seven years of industry experience. As P05 was a part of Finance as well as information technology, P05 needed data at a regular basis for making business decisions. P05 considered herself highly computer literate. P05 came from a financial background and had no experience working with scripting or programming languages.

#### 4.1.1.6. Participant 6

Participant 6 (P06) was a female employee working for the sales and marketing department. P06 had been working for the current company for two and one-half years and was actively involved in metrics reporting and business analysis. P06 had a technical background and was familiar with several computer programming languages as well as scripting languages. P06 considered herself highly computer literate. In addition P06 also mentioned that she had worked earlier with salesforce, which is a business intelligence solution provider. P06 made use of data regularly for metrics reporting and submitted the dashboard created to higher management.

## 4.2. Data from Interview

This section will provide the data that was collected during the interview conducted with the participants mentioned in section 4.1. As discussed earlier in chapter 3, the goal of this interview was to capture the experiences of participants with a dashboard. Table 4.1 shows the order of participant interviews.

Table 4.1.

*The order of participants in Interview*

| Order | Participant | Order | Participant |
|---|---|---|---|
| 1 | P01 | 4 | P05 |
| 2 | P03 | 5 | P02 |
| 3 | P04 | 6 | P06 |

4.2.1. Participant 1 Textual Description

P01 introduced herself by stating that “I have been working with [this company] for about eight years now and umm…before joining this company I was working as a SAP supply chain consultant” P01 acknowledged that she came from a strong technical background and had been a part of several projects that included development of dashboard. “SAP also has a business intelligence module, not currently but say in my previous projects I have also helped different companies to implement a dashboard”.

When asked as to how the participant generally analyzed her data and made decisions, P01 stated that she made use of graphs and charts to analyze the data she received. “I generally do a adc graph like a thing from excel, but I have never done a pictorial graph but, I do or prefer a visual depending upon how much data we are talking about or umm...to analyze how much percentage is what ”. Based on the previous question when asked if P01 used Microsoft Excel to analyze her data P01 responded by saying “Yes, Excel otherwise Access to do so. I generally run queries to analyze the data.” P01 acknowledged that though metrics and dashboards were a convenient way to analyze data they had some access related issues limited specifically to production. “Yes, it is more convenient umm... I have not faced any problems as yet, but you know it is more access limited so we do not get to run all the reports we require at least related to production. In production you need to refresh the data and it takes time so it is convenient to download the data and run query umm… but it would be convenient if we had a tool to do so, umm... that would be more useful.”

P01 explained in detail about the response rate by stating that:

> It depends upon the system performance, doesn't take that long, but for the query to run and update the dashboard would take a little while and in production we cannot afford to umm… have a small glitch in data we are using. Accurate and updated data should be available.

When asked whether P01 thought that a dashboard improved the decision making process. She said:

> See dashboards are very visual so they might be, like you do not need to see the data inside. Umm… like it shows percentages on the graphs so you don't need to see the actual data…yes, for higher management it is very important, they prefer to see this as compared to data but for technical people umm… not sure if they would prefer to see this. For technical people it does not matter whether you give them data or dashboard, they can visualize and analyze the data but for non technical people it will be more useful. If data is moved around in the company from an analyst to the manager the integrity can be lost so I think that everybody likes to see the data themselves right?

P01 also mentioned that dashboards made the process faster, "Yes, it would help you, like if you write a query or whatever that generates a graph and show than it would be faster right, rather than writing queries again and again to generate data sets". When asked whether it is worthwhile for a company to invest money in deploying a dashboard P01 said "Umm... Yes I think it is worth it because they say that high executives/directors just look at all this to make their decisions and not the raw data. So I think absolutely it is important at VP level".

P01 said that design of the dashboard was not very important in terms of the colors and format:

> As long as it is accurate, I think umm… it as long as it depicts the information correctly umm... I think it shouldn't matter right? May be it plays an important role in terms of CIO, they might want to see it in a different format but as long as the data is current it should be ok.

P01 also stated that in the design, placement of data was more important. She explained:

> Eye catching data would impact the decision-making process, definitely. I believe it should have different views…like sales and marketing should focus more on sales data while finance doesn't care much about sales data. Customization should be there, like here we do have lot of customization in the dashboard. Like for VP level and director level they have different view or query. I am not sure what they call but yes they do.

P01 suggested some functionalities that could be added to the dashboard in order to make it more user-friendly. She described:

> It should be very easy to move around, if there is something that is not needed they should be able to hide it or flag it. It should be very user friendly, people who don't know programming should be able to use it with ease. More of drag and drop functionalities that we have in the dashboard, Umm... as I personally feel it makes things much easier.

#### 4.2.2. Participant 2 Textual Description

P02 did not give much information about her past experience but she stated that "As a part of my work at this company, umm... my daily work includes reporting, metrics reporting and managing the … project." When asked how often she used the dashboard she said "Daily, on a regular basis". P02 believed that a dashboard reduced the turnaround time but did not necessarily improve the decision making process "I think, umm... most of the times it does. I think it can speed up the decision making process umm...I am not sure if it improves the decision making process. It reduces the time of people who are looking at the simulated information".

She explained the functionalities she used in a dashboard:

> Umm... usually umm... milestone/objectives, percentage complete that is what I use it for…tracking against the goals or targets. The way I think dashboard works is that they present numerical information in a kind of alternative symbols that the brain is able to umm... gather more

> information in a shorter period of time. So, I can read the word late or I can see the color orange or may be I have 10 lates and 15 Umm...not late then it would be very difficult for me to convey that in words or numbers, that would have the aspect of umm…other person's brain and been able to assemble as quickly as possible, there is no comparison. [According to P02, she preferred or could easily understand the graphics (color) as compared to words (late or not late) denoting status.]

P02 also made use of Microsoft Excel for data analysis "I mostly use Excel just for the flexibility of it, in past I have used Crystal Reports and built pretty sophisticated reports with that". Based on her previous answer, when asked how she would compare Crystal Reports and a dashboard she reported:

> I always enjoy a dashboard which has a drill down or a dashboard that is accompanied with the details that it supports. I think data in a summarized fashion can be misleading so it is interesting and important for the recipients of the dashboard to have details, so yes drill down should be definitely incorporated in a dashboard.

When asked if she thought whether a dashboard helped in reducing time and cost, she explained:

> Okay, I think it reduces time for them to recognize that they have a problem, I really don't know if it helps the decision making process, that's a different thing. Recognizing that you have a problem and coming to a decision of how you are going to solve that problem is different. It can actually affect the decision in not so good way umm... if you have a management that is too reliant on the dashboard and summary and not on the details it can be negative too. It is very common, when they get too used to it that they cannot look at anything else. The other thing too is I think that tends to occur is that umm... you can manipulate information with summaries, its statistical game right. The person who prepares the dashboard and maintains it has control over the product. So it is not necessary an honest tool umm... it can be but it also can be not. If people are making decisions based on just that and not details in fact they can make wrong decisions and it can end up spending more money. And the other thing, the time to set up a dashboard and the huge cost associated with that umm…I often wonder if it is easier to train, have managers have more patience to look through more details or come up with a more transparent non-massagable summary dashboard would be better [P02 meant that a more detailed dashboard would be more useful.]

P02 believed that it was not worth investing a substantial amount of money in a dashboard. She explained it further by saying:

> I think if I have to spend I would spend that money on other things, as I said it's just as good as the honesty of the person who prepares the dashboard, so I think it is good tool, but it is good for the person who is actually monitoring the information not necessarily presented as single or only picture that management should look at. I generally face this problem as oh it's ok just give me the dashboard, but you don't understand that you are not looking at the whole picture and driving yourself further and further away from real problems. But drill down is good. Yes, because how do you know it is accurate, if you cannot go and see the data? It also decreases the curiosity, if I don't have a drill down I will have to be dependent on someone to get reports and look at the data.

P02 accepted that use of graphics on a dashboard helped to retrieve information much faster. "Absolutely, as brain can interpret that multiple times faster…specially incorporation of color. I think sizes will be important but the word READY and box green…umm are differentiable". When asked if placement of data on the dashboard affected the decision making process she stated:

> I don't know. I can't say. It is like asking someone you like modern art or you like classical art? Umm everyone is different, everyone's brain is different. I don't know if I can answer this question. Some people can catch data easily so having much information is ok, not that you cannot read it but umm for sake of time like you have group meeting or something to show, everybody is as if going to look at the stuff. But it is also interesting to compare the data when you have different views for different functional area. Like how you are better than others and how far behind you are as compared to other departments. I think that can help a little bit. [She believed that use of graphics could deliver status updates in an easily comprehensible manner.]

She suggested some functionalities that might help in improving the decision making process.

> As I said earlier too, I feel looking at the raw data is very important, so it would be good to have a pop up or drill down button umm…that can allow people to go in and see what the graphs or chart is all about.

4.2.3. Participant 3 Textual Description

P03 had been working in manufacturing operations that is considered a part of the Supply Chain department. “I have been working with this company as a process engineer in the manufacturing ops (Operation) department, umm…we do get involved in lot of pricing and material management, as umm… it is a part of Supply chain department at the top”. P03 used data on a regular basis:

> Oh yes, we require data related to vendors, materials, purchase orders umm... even product release status on a daily basis, our department cannot function without getting appropriate data. We observe millions of products, material going through the production line, we need updates on very large quantity of data, umm…as you know our company uses SAP and we have different transactions to run our queries, I umm…use transactions, to…to display or view the specific information or data I want to analyze. If we are talking about several materials and comparing it with different vendors it is being delivered to, it is umm... unproductive to look at the tables, so I generate a chart and my brain can read it much faster.

When asked if he used Microsoft Excel or any other tool to generate the graphs for analyzing the data, P03 said:

> Yes, sometimes, well it depends, if I am looking at the data in SAP, why would I import it to Excel? I can use the graph function and create a graph, in production we generally use dashboard or you can say metrics as we need much comparative data, in terms of number goods shipped, products ordered, time and date it was shipped, so what I mean is umm…it is difficult to look at numbers and compare different products or materials and their attributes and for that purpose we have a metrics that is used by our department. But unlike other departments, we need real time data on production line, I would say if they make dashboard more efficient in terms of responding to the queries it would make it more useful for our department.

When asked if graphical presentation of data on a dashboard or metrics helped in making decisions. P03 stated:

> I am not sure if I would like to say that it improves or helps in making decisions, but umm... yes it, it reduces the total and manual work involved in moving around the information, as well as it is a proven fact that our mind reads and understands pictures much easily as compared to numbers, right and umm… in manufacturing we deal with lot of numbers. But yes, dashboard as a whole umm…reduces the total time and preserves the integrity of the data being delivered.

P03 also mentioned that though dashboard was helpful in analyzing the data, it was not worth the total investment.

> If you ask me in particular about just manufacturing or supply chain yes, it is worth it and umm... pays back, we deal with humongous amount of data, and we do require real time data, but I am not sure if it is useful to the whole company. I like all kind of graphs, charts and those fancy things displayed and it is certainly useful, but umm... if I were to invest so much, I might not may be…We can use Excel, Crystal reports, Access umm…SAS and so many other available softwares to run reports and they also provide charts and graphs, dashboard is a huge expenditure for the company and umm we also need to provide training for that.

4.2.4. Participant 4 Textual Description

P04 had been working as a project manager in the Information Technology department. “I am with this company for 3 years now, I have managed several projects like umm...mostly projects related to SAP implementation and data warehouse integration”.P04 explained the approach he followed to analyze the data and make a decision.

> Depends, highly depends upon how data is formatted I mean typically I look at the pattern, aggregate, if umm…it is financial data I try to sub review it, if management data I look it at project level, profit center level, higher level which helps to look at profit and loss, I generally look at the higher level and try to drill down and dig in for more details. Say you got an issue for example financial data and you know your organization or whatever has an issue , I try to find out what the problem is, where the problem comes from at a high level and then look at the data to drill down and find which departments are contributing to the problem and how much. Umm...I try to divide it based on what division and geography.

When asked if he used any other tools like excel or metrics for decision making he described:

> Umm it depends, are you talking um… actually it depends on what context you are asking, I mean do you mean as in my day-to-day job? I actually work as a Project manager for IT department so umm I am mostly responsible for lining the deliverables, resources and all those stuff. But in Project management if you ask me umm I make use of most of all the tools like Excel files as well dashboard for making decisions…ahh…related to my role. Umm...for example lets say resource allocation, I have a way where I try to list all the deliverables, tasks that should be done, look at the time it takes and when it should be done. I generally prefer to make use of Microsoft Project to prepare my own metrics and send it to my team. Don't you get my metrics for daily checkpoint?

P04 made use of a dashboard for decision making. He mentioned several instances where he used dashboard for analyzing data and making decisions.

> Definitely I do get the data, for example which resources are currently allocated for 20 hours or 40 hours I do take it from the SAP. Or say I need to compare the overall standing of our team with BI functional or data integration team, Yes I do use the dashboard. Generally senior manager or PMO they use dashboard much more umm... we know they don't have time to dig in everything so there is where graphic helps. If you talk about the graphics umm… on dashboard used by me or in PM, we use it much for something like earn vs. burn. That earn work gets accumulate as work is done. But if your earn gets increasing I am sorry, I mean your burn gets increasing and your earn is constant that means we have a problem [earn = project's profit and burn = project's spending], so that is just an example where we make use of graphical representation. Other area where you are on the project is defects, in order to see how many P1, P2 or P3 defects we have and here is how many defects we opened in a week , here is how many defects we closed in a week , rite ? [P1, P2 and P3 are the level of defects, where P=1 highest priority defect and P=3 lowest priority defect]

When asked if graphical presentation in the dashboard helped in analyzing data, P04 said that any kind of dashboard helped in analyzing the data. It did not necessarily have to be a graphical dashboard, "umm… you know umm… any kind of dashboard whether it has numbers or charts it helps umm… until [as long as] you

know where the data comes from and how it is derived". P04 acknowledged that presentation was very important in the dashboard. "Right, presentation is important. Whether it is a dashboard on your computer screen or just on a PowerPoint umm... the important data should be upfront as umm…what I mean on the first page". In order to improve the design of the dashboard P04 also gave some feedback. "I strongly believe that dashboard is more used by PMO [Project Management officer] and people at VP level, so there should be a section like umm...help or something similar to FAQ [Frequently asked Questions] that might help them, even customization to a certain extent that makes it easier…umm…for the user to see and find what they are looking for." Based on the feedback provided by P04 when asked if he meant something like a drag and drop functionality he said. "Umm…It can be a drag and drop functionality also, or let's say different views that make it more user-friendly for non-technical people".

#### 4.2.5. Participant 5 Textual Description

P05 came from a finance background but had been working with the Information Technology department for two and one-half years now. She had previously worked with a dashboard in another health care firm. "I have been with this company's IT department probably for now about 2 and ½ years and previously I worked with another company". She reported that a dashboard improved the decision making process by making the communication more transparent around the organization "I think dashboard improves decision making process, because if you look at this way I come from a very strong finance background and prior to SAP basis project as you see in UNITY [name of a project] there are several tracks in it so how do people make sure that the communication is very transparent, not only the users and key stakeholders but outside of the project but between the SME who actually works in the project, having a BI dashboard your process of decision making is going to be more efficient, why is because if you look at IT we get all the information from the SAP dashboard, like source ledger which is like one of the bibles for posting and all".

She further stated that:

> I am trying to say is that if the CPR [Cost Performance Report] gets all the information from the system, you are communicating the biggest changes coming through. So if there are application owners who want to stay informed at several phases in the project, we finish our requirements gathering, we got into functional design phase, we completed configuration and now we are in test phase and then we will start the deployment phase. So the biggest concern is that I am an application owner, other than the newsletter or memo you get umm... there is an application/website that keep track of this. How much resource was allocated, so that I can make changes to the metadata structure? So I can buy my financial packages in a timely manner. So I think dashboard is like umm…you can ping each other rather than an instant messenger or chat session. I get answers like um…should I be concerned if the metadata changes? Should I be concerned if the sales structure changes? If you look at it 10 years ago there was no interlink between IT and Finance. The day I graduated I started working as an accountant, I being both IT and finance person could understand but there is always a language barrier between them. So I think dashboard is a very good idea in terms of this age, you need something like that so that you can ping questions/ ask questions and stay informed. I would like to know how R&D projects impact our project and things like that.

P05 had used various tools that include Hyperion and scorecards for making decisions. She further explained:

> I have been with this company probably now about two and one-half years and previously I worked with another company...ok and one thing I noticed is I have spent number of years in IT and for me to stay informed about other innovations in IT, other innovation in finance and other innovations between different product lines is important. P&G has more than 23 different product line and Gillette has about five so if you integrate both its lot more. So you want to keep up with the market place, right? So in terms of the tools, in terms of the system tools, what happened was when I came into this project or this company I was asked to do CPR and we went through a next generation Hyperion tool and I was able to go through the project successfully and I got a scorecard, the other day I was called in for a happy hour and they told us that it was the only system that didn't have any problem because of the scorecard I put to gather and I had that experience from Procter and Gamble. It is not because of the experience but because of staying informed. We have a dashboard out there, we should intermingle not only for finance, IT, SM or legal but more with other

> departments too to stay informed if a new product came out how much sales forecast we need to update in our system.

When asked if she used tools like Microsoft Excel and Access with a dashboard to make decisions she replied stating that:

> I think if you have a dashboard it is more like a website where you have different links umm…it could be regarding any projects. Only when you trying to retrieve the numbers out of it, but I don't think any other application is required as it is too detailed. We already have systems to retrieve data so dashboard is not used for that. I think there should be job oriented dashboard vs non- job oriented dashboard. And the job oriented dashboard is that I am having trouble with the Pivot table, where people with experience related excel can ping each other and say 'Hey I have problem with Pivot table, have you taken advance courses related to excel and would it be advisable for me to take those class? So they can be more advanced in their job roles, so that what I think dashboard should be, not only staying informed about the project but something you can also develop yourself with and staying informed with the market places role.

Based on her answer, when asked if she thought whether customization should be incorporated in the dashboard she said:

> I think dashboard is pretty much used is like a website. One of the areas where I would like to keep in touch with that we have associates from another company and I would like to know what they are doing and because of how the economy is changing as we speak of it is evolving…hmm…if I need to take classes, what classes are going to benefit me in the leadership roles, adapt to the economy as they changes. Things like that is what dashboard should look like, it should not be just job oriented. It should be more like networking. And I feel the corporate culture over here in [this company] is like that, the company where I came from we just didn't say 'hello' in the kitchen or the hallway, we said hello through the dashboard. You can stay informed and get ahead too.

She also acknowledged that graphics made the information easy to understand. "I wonder why, I am just thinking in direction that why people would go…hmm…to dashboard to get there chart in terms of how we are performing. I would get that information elsewhere, why would I go in dashboard to get that information. But I am a visual person so when people come in here and talk about information it goes

through me, so show me something visually so that I can connect the dots and I can probably provide feedback, right. And I can actually digest that information take it back to where I need to take it. But I strongly recommend that if we have a dashboard we do have visuals in that." She also further added that additional functionalities like drill-down should be included in the dashboard. "I think it would be good to have back-up or support when you have numbers attached to that chart, when you have X & Y I would surely like to see what that X means, that information would be surely helpful."

When P05 was asked whether it was worth investing in a technology like dashboard, she said:

> I think so, because the return on investment or investing on dashboard right, you have people talking to each other more right? I think we should encourage people, subordinates; management to use such tools that helps to stay informed which can actually help us to be more efficient because at the end of the day we are multitasking. When I joined the company few years ago, we had to use phone for each and every thing and that was ridiculous and we had a business improvement session and I suggested having a tool like this where everyone can be on it. If people get trained enough on navigating through the dashboard their job can be more efficient in terms of getting the information they need. Umm…the problem with that is that obviously there is capital that needs to be invested, but the return on investment would be instantaneous. Not only for job –oriented task but like how do you learn about R&D? This is how you become more versatile.

#### 4.2.6. Participant 6 Textual Description

P06 introduced herself by stating that: "I have been here at [this company] for now two and one-half years, infact I will complete three years this May" She came from a strong technical background and had worked with several data reporting tools in the past. "I am part of the global data reporting team; we analyze most of the sales data to study the trend and patterns. At [this company], umm... we use our own in-house developed tool for reporting, but I have also worked with other tools like…umm...Cognos even Business Objects."

When asked as to how she analyzed her data and made decisions, P06 said that she made use of the in-house data reporting tool for analyzing the data. “We have an in house tool, most of the times I use that as it has pretty tables and…umm… also generates graphs and charts for me. Umm…I would say it is convenient as compared to importing the data and analyzing it. In sales we generally need data for comparing sales between different quarters, making decisions on Pricing, compare the sales between different regions, so it is much easier to look at the data at one place rather than hand it over in files and pass it on. P06 acknowledged that a dashboard reduced the turnaround time and eventually helped in the decision making process. “When I need data, I don’t need to write queries or make phone calls, I am bad at remembering things. Umm…I think it (dashboard) makes data readily available. I spend less time searching for certain data as what I need to do is just open my browser and log in”.

P06 said that the graphical user interface helped in understanding the data rapidly. She explained:

> I think it is human tendency to get attracted by graphics or pictures as compared to words or numbers. Let us take an example…umm...if I need to find the total sale of Taxus worldwide and compare it across different quarters, it may take me or any one sometime in understanding the trend, but if you give me a comparative bar chart and a pie chart with different quarter results umm…I can analyze it much faster. I think our mind can easily read pictures as compared to numbers.

When inquired about the placement of data, she said:

> I don’t think placement of data matters to me personally, if you know how to get around and navigate, it is not that important. Umm…I come from a technical background and I have used dashboard for quite a bit so may be that can be a reason but I don’t think placement is that big an issue.

P06 also acknowledged that dashboard should be used appropriately in order to get a good return on investment.

> Definitely dashboard is a huge expenditure, but if you see it also makes data transparent, right? It highly depends on the way it is designed too, umm...I think it should not be just a superficial picture with glossy graphics; a detailed version should be available too. There are several other factors…umm...training and we are a regulated company so we have to keep up with our training goals and documentations whenever there is a small change in the system. Even additional resources are needed to implement or maintain such system. But…umm...but I feel if it is used accordingly than it can have a good return on investment in a long run. I mean no system has just right on time returns.

P06 suggested few features that should be added to the dashboard to improve usability. “I think in order to make it more user-friendly we can have easy navigation to move around easily and make it less cluttered. I think…umm...user should have capability to hide or remove the data they don’t need. Like say I want to just see Q4 sales, I don’t want to see Japan or Austria’s data; I should technically be able to do that.”

## 4.3. Summary of Qualitative Data

The following sections summarize the qualitative data gathered from interviews.

### 4.3.1. Supply Chain Department

The interviews helped in revealing valuable information. As the supply chain department is indirectly linked to manufacturing operations, it requires a higher refresh rate in general as compared to other departments. Though the employees interviewed in this study made use of a dashboard for analyzing an extensive amount of data, they were disappointed with the response rate in particular. It was interesting to find that in production they faced several access related issues and as a result they preferred to make use of Access or Excel to run reports and create graphs. Though the dashboard provided visual data that helped in a faster decision making process, they did not agree that it was very useful for technical people. They acknowledged that a dashboard helped in reducing the total amount of time spent on the decision making process but did not confirm that it necessarily improved the

quality of the decision making process or affected the end outcome. They believed that because a dashboard required a substantial investment in terms of training and implementation, they did not expect a dashboard to yield a good return on the investment across an organization. Lastly, it was also noted that use of a dashboard preserved data integrity. It was recommended that some additional features such as those listed below be added to a dashboard to facilitate a better decision making process:

- Drag and Drop functionality
- Customization based on roles
- Hide/Flag the components.

### 4.3.2. Information Technology Department

The Information Technology department consisted of more technically oriented people as compared to other departments. They believed that because a dashboard was used more frequently by higher management and non-technical people, it should also include a FAQ (Frequently Asked Questions) section to provide support to such a target population. According to them, a dashboard assisted in the decision making process; it was also a great tool for communication as it kept information transparent throughout the organization at all times. They acknowledged that a dashboard kept everyone constantly informed about different processes and action steps being undertaken in various departments. They agreed that it was also easier to understand visual graphs and charts as compared to raw numbers.

However they noted that in order to ensure accurate and detailed reports, a drill down functionality should be added to the dashboard. They also stated that design and placement of data impacts the decision making process. Design and deployment of a dashboard would entail a significant investment by the company, but if the users were trained appropriately it could potentially add to the bottom line of a company in the form of time saved during the decision making process.

4.3.3. Sales and Marketing Department

Users from the Sales and Marketing department agreed that a dashboard reduced the total amount of time spent on the decision making process and made the data more visible across the organization. Employees from sales and marketing generally used a dashboard to compare their sales and goals. They thought it was easier to look at the dashboard as it made all the data accessible in one place. In addition they suggested that a dashboard should not only consist of pictures and graphs but should also have detailed reports. Absence of detailed reports and the presence of only charts or graphs could possibly mislead higher management and prove detrimental to the organization too in certain cases. They acknowledged that the visuals were helpful in identifying problems and further analyzing the data but also noted that a summary report should be incorporated with the graphics. They stated that a dashboard helped in understanding the problem faster but did not necessarily offer a solution to enhance the decision making process. Lastly, as far as the display or design of the dashboard was concerned, they did not believe that any particular physical location or placement of data affected the rate or quality of the decision making process.

Participant's had different views regarding benefits of the dashboard. According to P02, a dashboard is not dependable and hence not worth the investment. While P06 felt that a dashboard's benefits would outweigh its cost in the long run if it was used appropriately and efficiently. Participants from Sales and Marketing recommended that a dashboard have a couple of basic features such as those listed below:

- Easy Navigation
- Customization (Hide/Delete data)

## 4.4. Quantitative Data

The ratings provided by the subjects in the first question of the questionnaire were used to derive the comparative analysis. As the question was used to draw a comparison, a four choice scale using the forced choice method was chosen where (1=Strongly Disagree, 4=Strongly Agree). The responses for each functionality from each user within a particular group were used to produce a mean response for each group (Supply Chain, Sales and Marketing and Information Technology). An ANOVA test was conducted on the data collected using the survey questionnaire for testing the differences between the functionalities used by three different departments. The sample size that was used for this survey was 18. For a confidence interval of 0.95 and power 0.8 the sample size was enough to have 0.66 effect (large difference effect). Table 4.2 shows the statistical analysis that was carried out on the responses gathered from question 1.

Table 4.2

*Statistical Analysis for use of different functionalities between the departments*

| | SC (Supply Chain) | | SM (Sales & Marketing) | | IT Information Technology | | T-test Analysis |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | P-value |
| Historical view of data | 2.83 | 0.56 | 3.0 | 0.4 | 2.83 | 0.56 | 0.89 |
| Data Filtering Capabilities | 3.5 | 0.3 | 2.83 | 0.56 | 3.83 | 0.16 | 0.029 * |
| Integration with data warehouse | 2.33 | 1.06 | 2.66 | 1.06 | 2.83 | 0.56 | 0.65 |
| Data Visualization | 3.66 | 0.66 | 3.5 | 1.5 | 3.83 | 0.16 | 0.77 |
| Customization | 2.16 | 2.16 | 2.66 | 1.06 | 3.16 | 1.36 | 0.39 |

According to the results of the data analysis, as shown in table 4.2., there was a statistically significant difference between the usages of the functionality (Data Filtering capabilities) across different departments. However, the other four (Historical View of Data, Integration with Data Warehouse, Data Visualization and Customization) functionalities did not show any statistically significant difference across the three departments. Figure 4.1 shows the comparative analysis of the most commonly used functionality within the three departments.

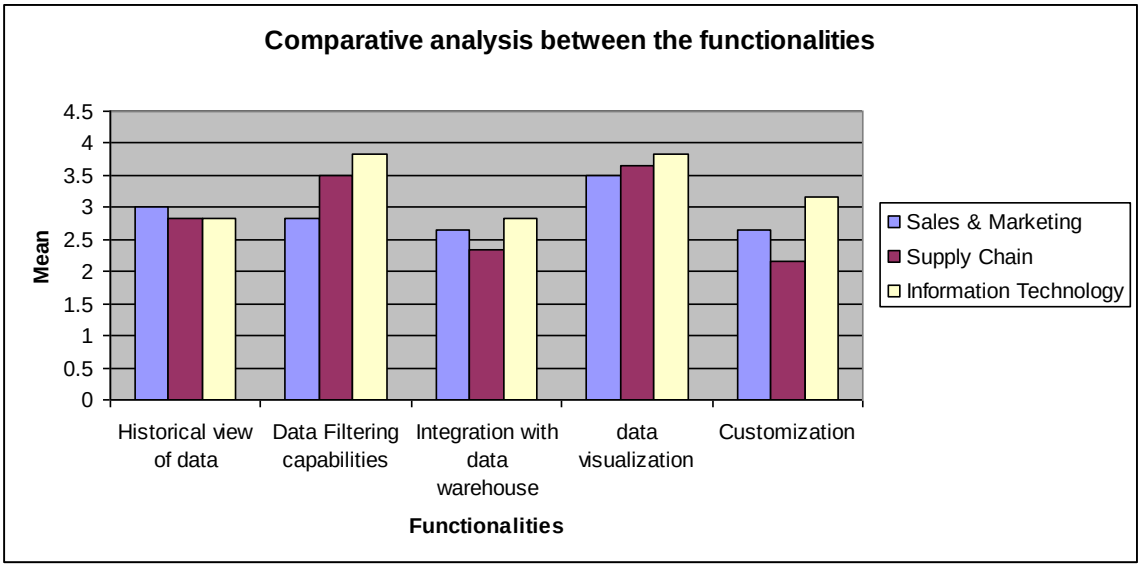


*Figure 4.1 Comparative Analysis of usage of functionalities across three departments.*

The second part of the survey consisted of nine questions based on the ranking provided in the first question. The questions focused on evaluating the effectiveness of the dashboard in the decision making process. The responses were collected on a five point Likert Scale. The overall comparison of the effectiveness of dashboard was tested by conducting an *ANOVA* test on responses from the three (Supply Chain, Sales & Marketing and Information Technology) groups. Responses for nine different questions on a scale of 1 to 5 (1=Strongly Disagree, 5=Strongly Agree) were added to yield a total number for each individual within a group. The totals for all the individuals within each group were used to yield a mean response for the

group. Table 4.3 shows the statistical difference between the mean responses pertaining to the usability of a dashboard in the decision making process.

Table 4.3

*ANOVA test analysis on the overall difference between the effectiveness of dashboard on decision making process*.

| | **DF** | **Sum of Squares** | **Mean Square** | **F-value** | **Pr>F** |
|---|---|---|---|---|---|
| Between Groups | 2 | 2.3333333 | 1.1666667 | 0.09 | 0.9141 |
| Within Groups | 15 | 193.6666667 | 12.9111111 | | |
| Total | 17 | 196.0000000 | | | |

As shown in table 4.3, the overall difference between the three departments was not statistically significant at the level of 0.05. There was no significant difference between the three mean responses of 34, 34.16 and 34.83 for the three experimental groups of Supply Chain, Sales & Marketing and Information Technology respectively. A box plot of the three groups is shown in Figure 4.2.

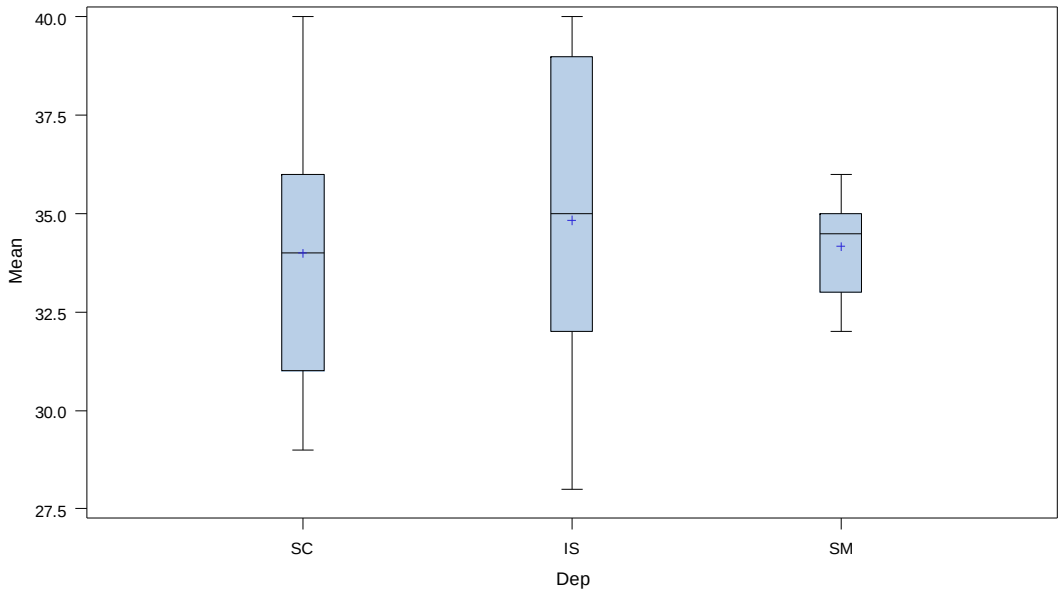


*Figure 4.2 Comparative effectiveness of dashboard across three groups.*

## 4.5. Summary

This chapter described various analyses used for purposes of this study. Visual graphs were used to display the results of the tests. The next chapter presents conclusions and recommends possible directions for future research.

# SECTION 5. DATA COLLECTION

This chapter summarizes the various analyses performed on qualitative and quantitative data. This chapter provides a conclusion and future possible directions for this study.

## 5.1. Summary of experimental results

According to results of the *ANOVA* test conducted on data collected through the survey questionnaire, there was a statistically significant difference at a level of 0.05 between the usage of the “data filtering capabilities” functionality between Supply Chain, Sales & Marketing and Information Technology. According to the results, the most commonly used functionality by Supply Chain, Sales & Marketing and Information Technology is data visualization. Statistically, a significant difference was not seen in the usage of other functionalities between three departments. Based on the responses gathered, it was determined that among all the three departments Sales and Marketing used the dashboard more frequently as compared to Supply Chain and Information Technology. It may be because they need to see less data as compared to other departments and hence are not concerned by the refresh rate issue with a dashboard. It was noticed that a dashboard might not be useful for all the areas due to its access related limitations. The quantitative data suggested that all three groups believe that the dashboard helps in the decision making process to some extent.

Employees from Information Technology are more technical. They believe that the dashboard is more useful for higher management as compared to technical people. Based on their job functions, they have suggested different features to be added to the dashboard to improve the decision making process. The Supply Chain department uses the dashboard for analyzing extensive real- time production data

that includes comparing different vendors and materials, while the Information Technology department makes use of the dashboard for reviewing any project's timelines, success and deliverables. As employees from the Information Technology department are more familiar with other technologies they make less use of the dashboard for analyzing the data. They consider the dashboard to be a useful communication tool. Users from the Sales and Marketing department use the dashboard for sales, pricing and forecasting. As their results are quarter-based for the most part, they don't seem to be affected by the delayed response rate of the dashboard. Employees from Sales and Marketing and Supply Chain did not agree that the dashboard improved the quality of the decision making process itself; according to them, it only helps in reducing the time spent on the decision making process. As a dashboard is a huge investment for the company and requires training as well as additional resources, it might not necessarily yield a good return on investment. Employees from Information Technology indicated that if users were trained appropriately a dashboard might justify the extensive expenses that might be involved in its design and implementation.

All the three departments believed that design of a dashboard did not play a significant role in the decision making process.. As mentioned in the literature review, data visualization aspect was the essence of a dashboard but as described by the subjects it should not only consist of graphs and chart but should also have an ability to run additional reports. From the responses it was noted that dashboard was more useful for people in higher management as compared to technical people.

## 5.2. General Discussion

This study focused on evaluating the possible effectiveness of a dashboard in the decision making process across three different departments. It further drew a comparative analysis between the commonly used functionalities offered in a dashboard among the three groups. This study was limited due to the fact that data was collected from a small population. Most of the subjects interviewed and surveyed were Senior Analysts, Project Managers or Managers.

## 5.3. Conclusion

The study was focused on evaluating the effectiveness of a business intelligence dashboard in the decision making process across three different departments and also drew a comparative analysis between the usages of different functionalities across the three departments. This study confirmed that there was a difference between the effectiveness and usages of dashboard across different departments.

Results of the quantitative data indicated that there was no significant difference between the effectiveness of a dashboard across the three departments. The mean response of the Supply Chain department was less than that of Information Technology and Sales and Marketing. The qualitative interview responses indicated that users from the Supply Chain department were not happy with the limited access and response rate of the dashboard. Also, there was a statistically significant difference seen with the use of the data filtering capability functionality. The Information Technology department used the function more as compared to Supply Chain and Sales and Marketing.

Based on the job function, effectiveness of dashboard varied. In conclusion, this study helped in identifying the difference between the usages of dashboard across the three departments and also identified additional features that should be added to the dashboard to improve its performance and effectiveness.

## 5.4 Recommendations for future studies

For further studies, the data can be used to add recommended functionalities to the dashboard to improve the decision making process and then evaluate the effectiveness of the dashboard. Open ended questions can be included in the survey questionnaire in order to gain more insight. Further a usability test can also be conducted to compare the total amount of time taken by all three departments for the decision making process. Finally the study can be conducted with a larger and more diverse group of subjects.

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Appendix A

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

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| | |
|---|---|
| **To:** | JAMES MOHLER<br>KNOY 347 |
| **From:** | RICHARD MATTES, Chair<br>Social Science IRB |
| **Date:** | 06/22/2009 |
| **Committee Action:** | **Exemption Granted** |
| **IRB Action Date:** | 06/04/2009 |
| **IRB Protocol #:** | 0905008081 |
| **Study Title:** | Business Intelligence Dashboard in Decision Making |

The Institutional Review Board (IRB), pursuant to Federal regulations, 45 CFR 46.101(b), has determined that the above-referenced protocol is exempt category (2) .

If you wish to revise or amend the protocol, please submit a new exemption request to the IRB for consideration. Please contact our office if you have any questions.

We wish you good luck with your work. Please retain a copy of this letter for your records.

Appendix B

**Background Information Questionnaire**

**Thank you for participating in this study. As you fill out the questionnaire below, please answer all questions and provide as much information as possible.**

Email: _____

Gender: ☐ Male ☐ Female

Would you consider yourself highly computer literate? ☐ Yes ☐ No

How many years of industry experience do you have? _____

Do you need data frequently for analyzing and making decisions? ☐ Yes ☐ No

Have you ever worked with Data Warehouse? ☐ Yes ☐ No

Are you familiar with any programming or scripting languages? ☐ Yes ☐ No

Appendix C

**Survey Questionnaire**

Please rate each of the statements listed below on a five-point likert scale.

1. What are the main design features/functions helpful in improving the decision making process?
    1. Historical view of data
    2. Data filtering capabilities
    3. Integration with data warehouse (external applications)
    4. Data visualization and analytics (Graphs, charts, indicators)
    5. Customization

2. The current design of the dashboard maximizes the efficiency of the decision-making process
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

3. .Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will facilitate the decision-making process when using the dashboard.
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

4. . Even if the dashboard redesigned to prioritize the features you rating in Question 1, other software programs like excel, access and external databases must be used in conjunction with the dashboard to speed up the decision-making process.
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

5. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will directly or indirectly contribute to the maximization of profit of your department.
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

6. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will assist in identifying problems much faster
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

7. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will assist in reducing manual work
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

8. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will assist in reducing the turnaround time of decision making process
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

9. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will assist  in retrieving information speedier
    1. strongly disagree
    2. disagree
    3. undecided
    4. agree
    5. strongly agree

10. Re-prioritizing the dashboard design based on the function ratings you assigned in Question 1 will assist with locating the data.

1. strongly disagree
2. disagree
3. undecided
4. agree
5. strongly agree

Appendix D

**Interview Questionnaire**

- Do you think the use of dashboard improves the decision making process?
- How often do you use the dashboard for the decision making process?
- What are the main functionalities most commonly used by you in a dashboard for decision making?
- Do you require any other tools other than a dashboard for decision making?
- What kinds of decisions usually warrant use of a dashboard?
- Do you think the design of dashboard affects the quality of the decision making process?
- Do you think use of a dashboard reduces the time and cost spent on the decision making process?
- What are the most common problems that are encountered while using a dashboard?
- Are there any other features or functionalities which should be incorporated in the dashboard to make it more usable?
- Does the graphical representation make it easy to analyze the data?